

**This Page Is Inserted by IFW Operations  
and is not a part of the Official Record**

## **BEST AVAILABLE IMAGES**

**Defective images within this document are accurate representation of  
The original documents submitted by the applicant.**

**Defects in the images may include (but are not limited to):**

- **BLACK BORDERS**
- **TEXT CUT OFF AT TOP, BOTTOM OR SIDES**
- **FADED TEXT**
- **ILLEGIBLE TEXT**
- **SKEWED/SLANTED IMAGES**
- **COLORED PHOTOS**
- **BLACK OR VERY BLACK AND WHITE DARK PHOTOS**
- **GRAY SCALE DOCUMENTS**

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**

**THIS PAGE BLANK (USPTO)**



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : G06T 9/00, H04N 7/50	A1	(11) International Publication Number: WO 99/12126 (43) International Publication Date: 11 March 1999 (11.03.99)
---	----	---

(21) International Application Number: PCT/KR98/00089

(22) International Filing Date: 14 April 1998 (14.04.98)

(30) Priority Data:  
1997/45740 4 September 1997 (04.09.97) KR

(71) Applicant (for all designated States except US): ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE [KR/KR]; 161, Gajung-dong, Yusong-ku, Daejeon 305-350 (KR).

(72) Inventors; and

(75) Inventors/Applicants (for US only): LIM, Young, Kwon [KR/KR]; 2-229, 236-1 Gajung-dong, Yusong-ku, Daejeon 305-350 (KR). PARK, Sang, Kyu [KR/KR]; 125-1102 Hanbit Apt., Eoeun-dong, Yusong-ku, Daejeon 305-755 (KR). AHN, Chie, Teuk [KR/KR]; 208-603 Expo Apt., Junmin-dong, Yusong-ku, Daejeon 305-761 (KR).

(74) Agent: LEE, Hwa, Ik; Young International Patent &amp; Trademark Law Firm, Daiheung Building, 4th floor, Suite 402, Youksam-dong 648-23, Kangnam-ku, Seoul 135-080 (KR).

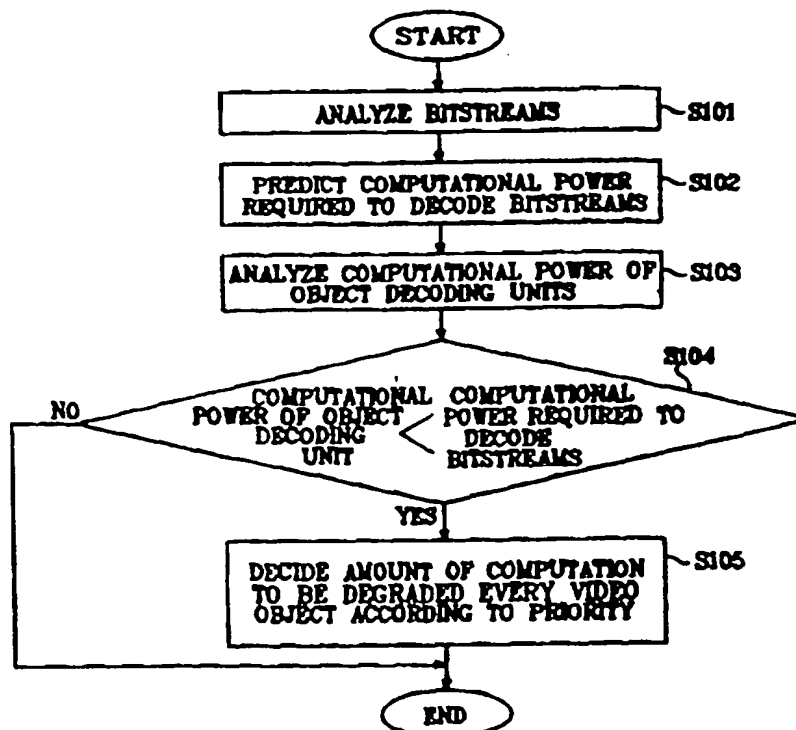
(81) Designated States: JP, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published  
With international search report.

(54) Title: COMPUTATIONAL GRACEFUL DEGRADATION METHOD USING PRIORITY INFORMATION IN MULTIPLE OBJECTS CASE

## (57) Abstract

There is disclosed a computational graceful degradation method using priority information in multiple objects case. The method degrades the amount of computation in different ratio every video object using the priority information if computational power of a decoder does not come up to that necessary for processing encoded multimedia data as decoding the multimedia data encoded by several objects unit, the priority information being determined by an encoder for optimal graceful degradation in terms of relatively visual importance between respective video objects.



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

**COMPUTATIONAL GRACEFUL DEGRADATION METHOD  
USING PRIORITY INFORMATION IN MULTIPLE OBJECTS CASE**

**Technical Field**

5           The present invention relates to a computational graceful degradation method using priority information in multiple objects case. More particularly, the present invention relates to a method for degrading the amount of computation in different ratio every video object using  
10   the priority information if computational power of a decoder does not come up to that necessary for processing encoded multimedia data as decoding the multimedia data encoded by several objects unit, the priority information being determined by an encoder for optimal graceful  
15   degradation in terms of relatively visual importance between respective video objects.

**Background Art**

20           Recently, the MPEG (Moving Picture Experts Group) standard, i.e., an international standard of media integration type moving picture compressing technique capable of compressing many informations, have been widely used according to development of multimedia techniques integrating audio, data and video.

25           MPEG techniques capable of compressing many informations are applied to a communication, broadcasting, home appliances, computer, CD-ROM, etc., to synchronize the audio and video, thus multiplexing the audio and video.

30           Generally, a bitrate of MPEG bitstream data, which is a system stream mixed with the audio and video signals,

is determined according to a kind of channel and memory or display. Such a bitstream data is received to the MPEG decoder and first, decoding of the system stream is executed to obtain audio bitstream informations, video  
5 bitstream informations and additional informations mixed into the system stream.

The prior art MPEG decoder decodes MPEG bitstream data to write the decoded results in an external memory. Then, the decoder converts the decoded results into analog  
10 signals so that we can hear the audio or see the video.

Generally, since each platform has different computational power, it is necessary to provide the maximum quality of the services which is achievable with the capabilities of each platform. And also, it is  
15 mandatory that all decoders can decode all MPEG-4 services but at different levels of quality. It means that a scalability based on computational power it is needed. The scalability should enable a graceful degradation of the quality when less than theoretically necessary  
20 computational power is available at decoding side.

The conventional computational graceful degradation method has been proposed in MPEG96/0925 by M. Mattavelli et al. to reduce the amount of computation when decoding the encoded multimedia data. The method decreases, in a  
25 lump, the amount of computation necessary for decoding without consideration of relative importance between the respective video objects if computational power of the decoder does not come up to that necessary for processing the encoded multimedia data. In the conventional method,  
30 however, there exists a problem which does not make full use of the relative importance between the respective

video objects.

The conventional method has considered only a single video object (VO) case. A video scene, however, is composed of multiple VOs which can be further decomposed into several video object layers (VOLs) in order to allow scalability. The various degree of visual importance of these VOs and VOLs should be exploited for the simplified decoding in the context of computational graceful degradation.

10

#### Disclosure of Invention

Accordingly, it is an object of the present invention to provide a method for degrading the amount of computation in different ratio every video object using the priority information if computational power of a decoder does not come up to that necessary for processing encoded multimedia data, the priority information being determined by an encoder for optimal graceful degradation in terms of relatively visual importance between respective video objects.

20

According to the present invention, there is provided a computational graceful degradation method in an MPEG encoder and decoder system comprising: an encoder including a multimedia object dividing unit for dividing an input multimedia into a plurality of objects according to its content and characteristic, a plurality of object encoding units for encoding the corresponding input multimedia objects from the multimedia object dividing unit, a multiplexer for multiplexing a plurality of encoded multimedia object bitstreams to transmit a multiplexed multimedia object bitstream; and a decoder

30

including a demultiplexer for demultiplexing the multiplexed multimedia object bitstream received from the multiplexer to output a plurality of demultiplexed multimedia object bitstreams, a plurality of object  
5 decoding units for decoding the corresponding multimedia object bitstream applied from the demultiplexer, and a multimedia constructing unit for reconstructing the decoded multimedia objects to generate a reconstructed multimedia to user.

10 The method comprises the steps of determining, in the multiplexer, a priority of the respective objects according to relative importance between the encoded objects before multiplexing the encoded object bitstreams to transmit, considering that the computational graceful  
15 degradation will be applied in the decoder, and determining, in the demultiplexer, an amount of computation to be degraded in different ratio every video object using the priority information determined according to the respective objects.

20 The step for determining the amount of degrading computation comprises after demultiplexing the input bitstream, analyzing the respective demultiplexed object bitstreams to predict the computational power required to decode the respective object bitstreams, analyzing the  
25 computational powers of the object decoding units, deciding whether the computational power of the object decoding units exceeds that required to decode the respective object bitstreams or not, and deciding an amount of computation to be degraded every video object  
30 using the priority information, if the computational power of the object decoding units does not come up to that



required.

According to the above present invention, the multimedia decoding which is more suitable for a characteristic of the respective object can be executed in the same case, by computational graceful degradation in terms of relatively visual importance between the multimedia objects having characteristic different from each other.

#### 10 Brief Description of Drawings

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the drawings:

FIGs. 1A and 1B are block diagrams showing an MPEG encoder and decoder system to which the present invention can be applied; and

FIG. 2 is a flow chart explaining a computational graceful degradation method according to a preferred embodiment of the present invention.

#### Best Mode for Carrying out the Invention

Reference will now be made in detail to the preferred embodiment of the present invention, examples of which are illustrated in the accompanying drawings.

FIGs. 1A and 1B show an MPEG encoder and decoder system to which the present invention can be applied.

Reference numeral 11 indicates a multimedia object dividing unit, 12a to 12n a plurality of object encoding

units, 13 a multiplexer, 14 a demultiplexer, 15a to 15n a plurality of object decoding units, and 16 a multimedia constructing unit, respectively.

First, in the encoder, the multimedia object dividing unit 11 divides an input multimedia into a plurality of objects according to its content and property to output them to the plurality of object encoding units 12a to 12n.

Next, each of the object encoding units 12a to 12n encodes the corresponding input multimedia objects from the multimedia object dividing unit 11.

Then, the multiplexer 13 multiplexes a plurality of multimedia object bitstreams which are encoded by each of the object encoding units 12a to 12n to transmit a multiplexed multimedia object bitstream to the decoder.

In the decoder, the demultiplexer 14 demultiplexes the multiplexed multimedia object bitstream received from the multiplexer 13 to output a plurality of demultiplexed multimedia object bitstreams to the plurality of object decoding units 15a to 15n.

Next, each of the plurality of object decoding units 15a to 15n decodes the corresponding multimedia object bitstream applied from the demultiplexer 14, and then the multimedia constructing unit 16 reconstructs the decoded multimedia objects to generate the reconstructed multimedia to user.

If the present invention is applied to the above MPEG encoder and decoder system, the operation of the system will now be explained. with reference to FIG. 2.

First, the multiplexer 13 determines the priority of the respective video objects (VOs) according to relatively visual importance between the respective VOs before

multiplexing the encoded object bitstreams to transmit, considering that the computational graceful degradation is applied in the decoder.

5 The demultiplexer 14 executes processes shown in a flow chart explaining a computational graceful degradation method of FIG. 2.

After the demultiplexer 14 demultiplexes the input bitstream, the demultiplexer 14 analyzes the respective demultiplexed object bitstreams before transferring them  
10 to the object decoding units 15a to 15n at step S101.

Then, the demultiplexer 14 predicts the computational power required to decode the respective object bitstreams according to the above analysis at step S102, and analyzes the computational powers of the object decoding units 15a  
15 to 15n at step S103.

According to the above analysis, the demultiplexer 14 decides whether the computational power of the object decoding units 15a to 15n exceeds that required to decode the respective object bitstreams or not at step S104.

20 As a result of decision, if the computational power of the object decoding units 15a to 15n does not come up to that required to decode, the demultiplexer 14 decides the amount of computation to be degraded every video object using the priority information determined by the  
25 multiplexer 13, thereby providing the amount of computation to be degraded with the object decoding units 15a to 15n.

If the computational power of the object decoding units 15a to 15n exceeds the required, the demultiplexer 14  
30 provides the demultiplexed object bitstreams with the object decoding units 15a to 15n without computation of

the amount to be degraded.

To encode a moving picture of the tennis player which plays tennis in the tennis ground is explained as an example. If encoding the tennis player and the background as respective video object, since most people are more interested in the tennis player than the background, it is a desirable strategy to keep the quality of the tennis player higher than that of the background. That is, the tennis player object is more relatively important than the background object.

Therefore, when the computational graceful degradation method is applied in the decoder, the multiplexer 13 can decide that the priority of the tennis player object is "one" and the priority of the background object is "three", so that the background object could be decoded with degradation of the computational amount three times as compared with that of the tennis player object.

Further, if the computational power required to decode the background object, which is predicted by the demultiplexer 14, is 30000 instructions per second and the tennis player object 2000 instructions per second, and the computational power of the object decoding units 15a to 15n is 40000 instructions per second, the computational power of 10000 instructions per second lacks totally.

Therefore, according to the order of the priority decided in the multiplexer 13, to degrade the computational amount of the background object three times as compared with that of the tennis player, it could be determined that the computational amount of 7500 instructions per second is degraded and encoded in case of the background object, and the computational amount of

2500 instructions per second is degraded and encoded in case of the tennis player object.

While the invention has been described in conjunction with specific embodiments thereof, it is evident that  
5 several alternatives, modifications, and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended to embrace all such alternatives, modifications, and variations as fall within the spirit and broad scope of  
10 the following claims.

#### Industrial Applicability

According to the present invention, the multimedia decoding which is more suitable for a characteristic of  
15 the respective object can be executed in the same case, by computational graceful degradation in terms of relatively visual importance between the multimedia objects having characteristic different from each other.

20

25

30

What Is Claimed Is:

1. A computational graceful degradation method in an MPEG encoder and decoder system comprising: an encoder including a multimedia object dividing unit for dividing an input multimedia into a plurality of objects according to its content and characteristic, a plurality of object encoding units for encoding the corresponding input multimedia objects from the multimedia object dividing unit, a multiplexer for multiplexing a plurality of encoded multimedia object bitstreams to transmit a multiplexed multimedia object bitstream; and a decoder including a demultiplexer for demultiplexing the multiplexed multimedia object bitstream received from the multiplexer to output a plurality of demultiplexed multimedia object bitstreams, a plurality of object decoding units for decoding the corresponding multimedia object bitstream applied from the demultiplexer, and a multimedia constructing unit for reconstructing the decoded multimedia objects to generate a reconstructed multimedia to user, the method comprising the steps of:

determining, in the multiplexer, a priority of the respective objects according to relative importance between the encoded objects before multiplexing the encoded object bitstreams to transmit, considering that the computational graceful degradation will be applied in the decoder; and

determining, in the demultiplexer, an amount of computation to be degraded in different ratio every video object using the priority information determined according to the respective objects.

2. A method of claim 1, wherein said step for

11

determining the amount of degrading computation comprising the steps of:

after demultiplexing the input bitstream, analyzing the respective demultiplexed object bitstreams to predict  
5 the computational power required to decode the respective object bitstreams;

analyzing the computational powers of the object decoding units;

10 deciding whether the computational power of the object decoding units exceeds that required to decode the respective object bitstreams or not; and

deciding an amount of computation to be degraded every video object using the priority information, if the computational power of the object decoding units does not  
15 come up to that required.

20

25

30

FIG. 1A

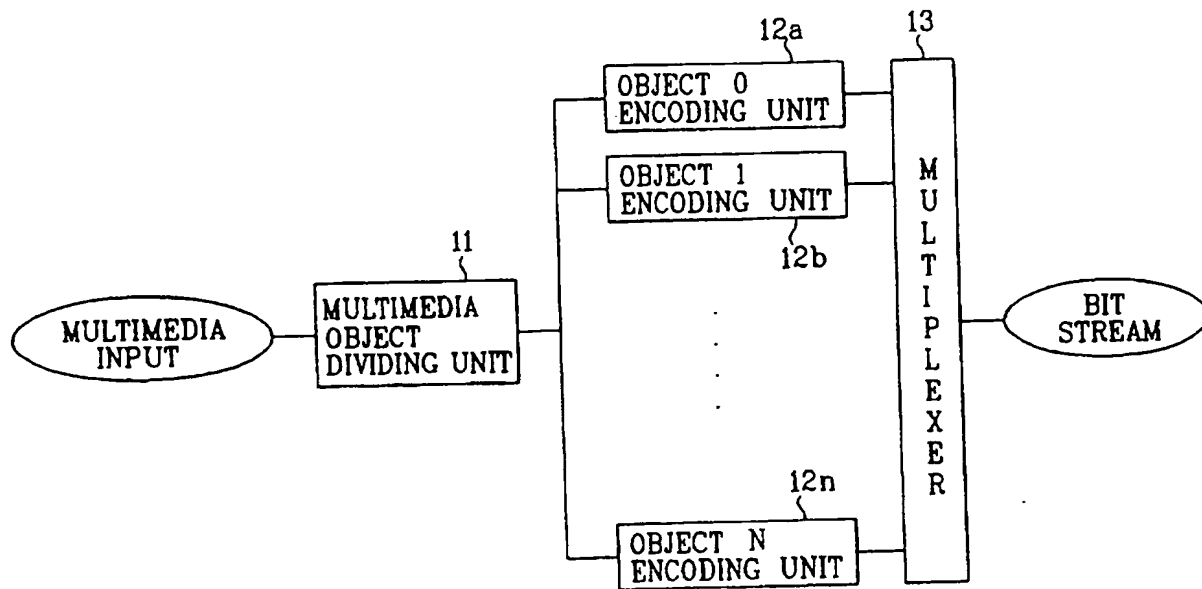


FIG. 1B

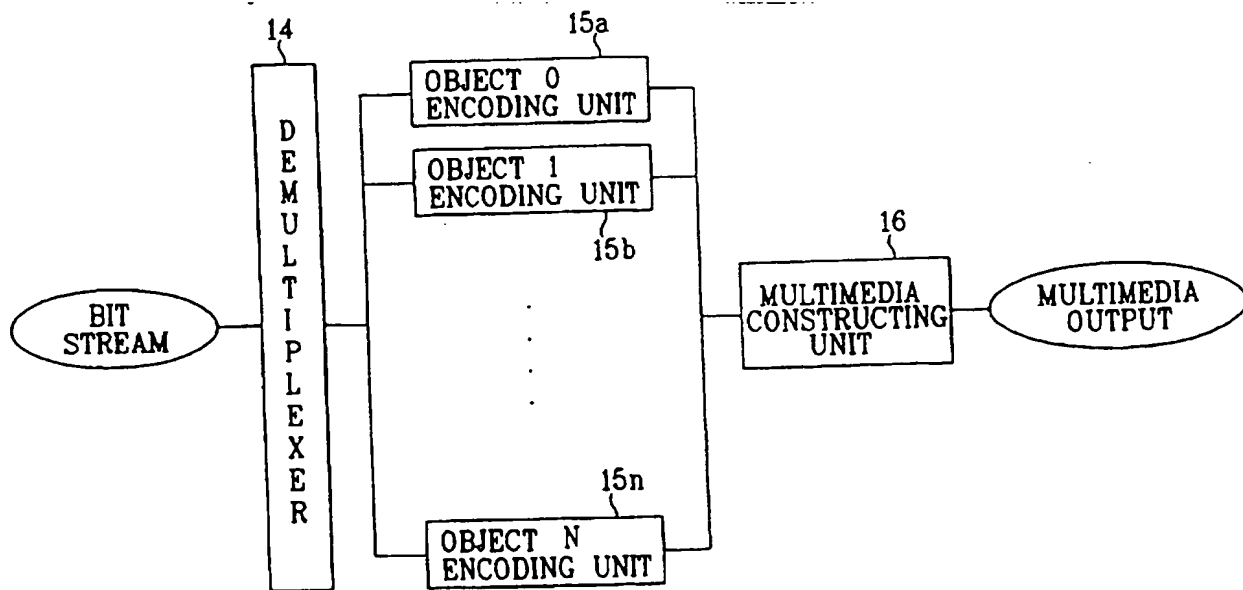
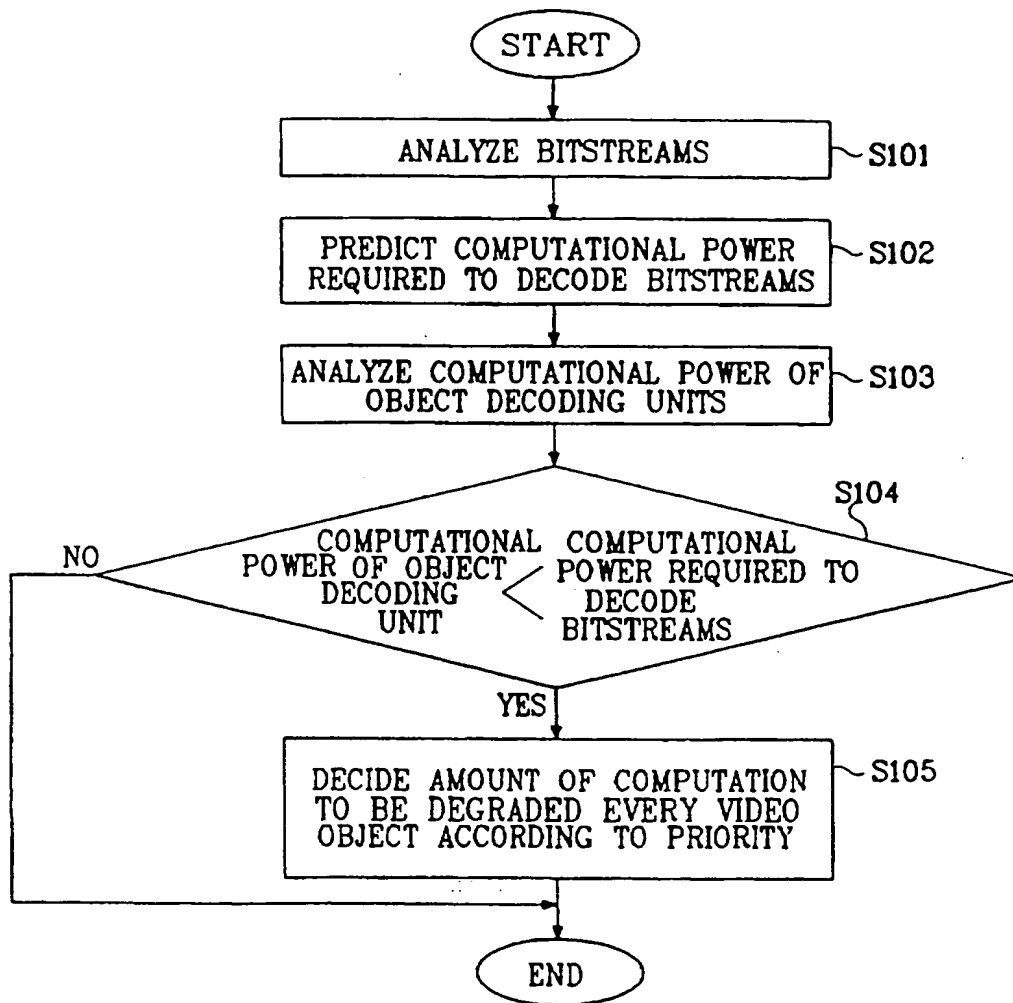




FIG. 2



# INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR 98/00089

## A. CLASSIFICATION OF SUBJECT MATTER

IPC<sup>6</sup>: G 06 T 9/00; H 04 N 7/50

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC<sup>6</sup>: G 06 T 9/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 96/42 169 A1 (S3 INC.) 27 December 1996 (27.12.96), abstract.	1,2
A	Patent Abstracts of Japan, Vol.96, No.9, JP 8-130739 A (SANYO) 30 September 1996 (30.09.96), abstract.	1,2
	----	

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

17 August 1998 (17.08.98)

Date of mailing of the international search report

24 August 1998 (24.08.98)

Name and mailing address of the ISA/

Austrian Patent Office  
Kohlmarkt 8-10; A-1014 Vienna  
Facsimile No. 1/53424/535

Authorized officer

Fastenbauer

Telephone No. 1/53424/447

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR 98/00089

<div>Im Recherchenbericht angeführtes Patentdokument Patent document cited in search report Document de brevet cité dans le rapport de recherche</div>	<div>Datum der Veröffentlichung Publication date Date de publication</div>	<div>Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets</div>	<div>Datum der Veröffentlichung Publication date Date de publication</div>
WD A1 9642169	27-12-96	keine - none - rien	

**THIS PAGE BLANK (USPTO)**